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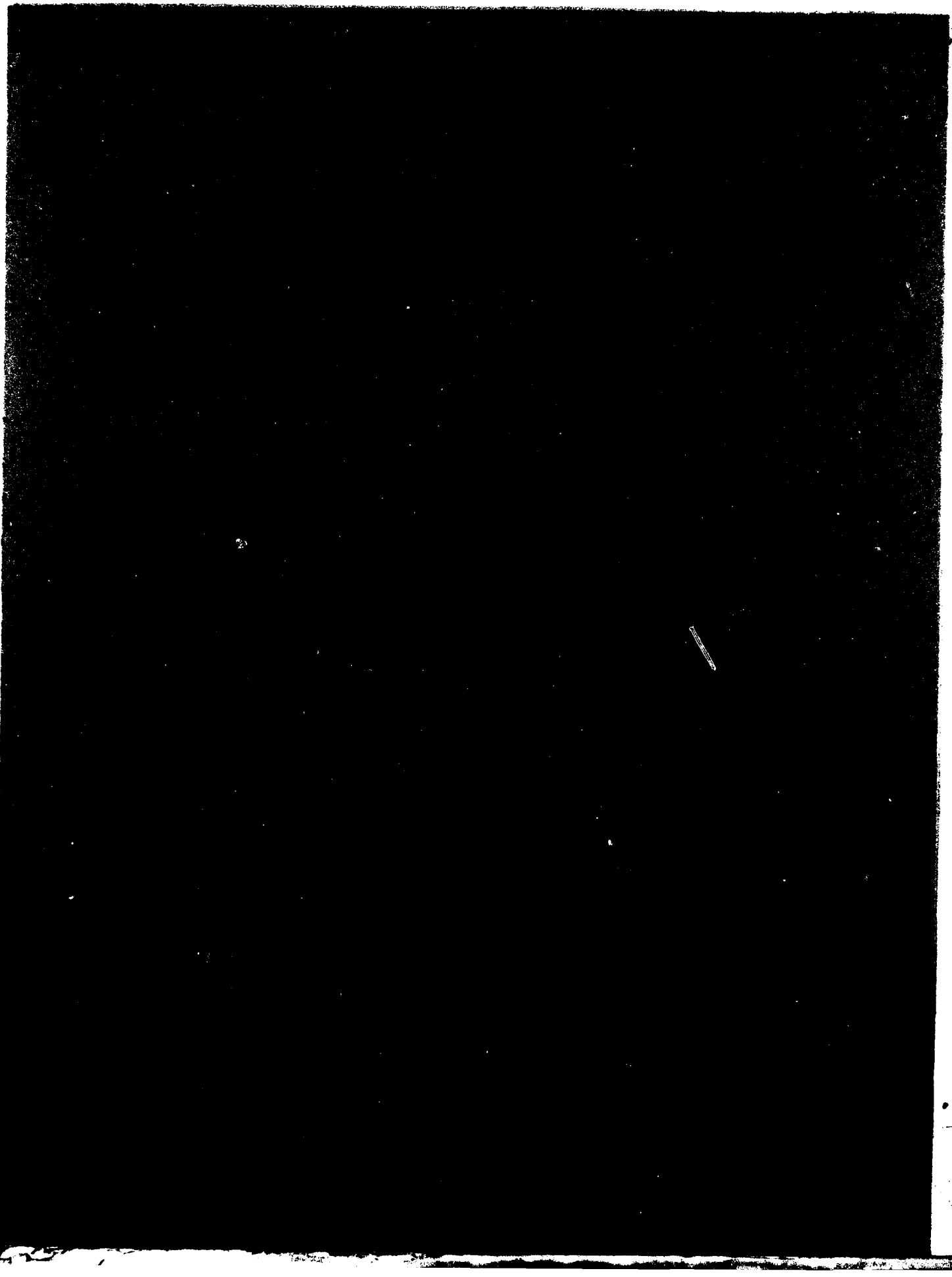

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The C-141A is a USAF heavy logistics transport aircraft. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this aircraft during normal flight operations. Data are reported for 12 locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level,

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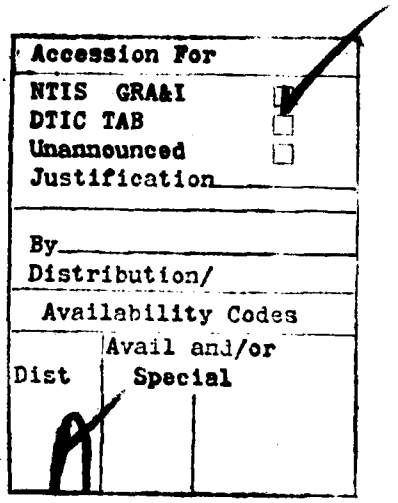
perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application", AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723108, Crew Safety in Operational Noise Environments.

The author acknowledges the efforts of Mr. John N. Cole who established the data analysis requirements, Mr. Henry Mohlman and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.



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INTRODUCTION

The C-141A is a USAF heavy logistic transport aircraft manufactured by the Lockheed Aircraft Corporation, Lockheed-Georgia Company. Power is provided by four TF-33-P-7 turbofan engines each rated at 21,000 lbs. maximum takeoff thrust. The engines are manufactured by the Pratt & Whitney Aircraft Group of United Technologies Corporation.

This volume provides measured data defining the bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the C-141A aircraft.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. *Refer to Volume 1* (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., in-flight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; AUTOVON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured C-141A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard C-141A environments, but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at various flight crew and passenger locations. The cargo compartment was configured with two seat kit pallets, and four cargo pallets. The two seat kit pallets were installed in the forward position in the cargo compartment with one being on each side of the center aisle. Table 1 lists the measurement locations and test conditions as numeric alphabetic designators which are used on the data pages. The designator 1A means measurement location 1 and test condition A.

The microphone position was at ear level external to headgear in a region 0.2-0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter and the resultant samples analyzed using a 4- or 8-second integration time to obtain a power-averaged level that effectively smooths out short-duration fluctuations and best describes the exposure.

Although the presence of a crew member or passenger at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurements locations.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the C-141A aircraft at the 12 specified locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These variety of measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1

MEASUREMENT LOCATIONS AND TEST CONDITIONS
C-141A, Travis AFB, Nov 1979

LOCATION	POSITION	HEIGHT ABOVE DECK
Crew Compartment		
1	Between Pilot and Copilot	Seated Head Level
2	Navigator Station, Seat Unoccupied	Seated Head Level
3	Flight Station Crew Rest Door Open	Seated Head Level
4	Flight Station Crew Rest Door Closed	Seated Head Level
Cargo Compartment		
5	Station 858 Left Side Wall	1.5 Meters
6	Station 858 Right Side Wall	1.5 Meters
7	Station 978 Left Side Wall	1.5 Meters
8	Station 978 Right Side Wall	1.5 Meters
9	Station 1098 Emergency Door Right Side Wall	1.5 Meters
10	Station 648 Right Side Wall	1.5 Meters
11	Passenger Area, Right Side Seats Occupied	Seated Head Level
12	Flight Attendant Station	1.5 Meters

CONDITION	DESCRIPTION
A	APU Operating - Forward and Aft Cargo Doors Open
B	Four Engines At Idle Power Setting Flight Station Door Open
C	Four Engines At Idle Power Setting Flight Station Door Closed
D	Taxiing - Four Engines At Taxi Power Setting
E	Takeoff - Four Engines At Takeoff Power Setting
F	Climb - 3000'
G	Climb - 10.0M to 37.0M
H	Cruise - 37.0M, 238 KIAS, 0.7 MACH, 1.7 EPR
I	Descent - 25.0M MSL
J	Descent - 10.0M MSL
K	Descent - 7000' - Landing Gear Down - Flaps OUT
L	Descent - 5000' MSL
M	Final Approach
N	Landing + Roll

TABLE: 2 MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND

IDENTIFICATION:
OMEGA 3.2
TEST AF-879-001
RUN 81
30 JUN 88
PAGE F1

NOISE SOURCE/SUBJECT:
C-141A AIRCRAFT
IN-FLIGHT NOISE LEVELS

OPERATION:

FREQ (HZ)	LOCATION/CONDITION 1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	2/H	3/H	4/H	5/H	6/H	7/H	8/H
25	72	71	71	85	83	78	78	78	77	76	71	73	73	72	76
31.5	66	74	71	86	86	74	80	74	73	76	72	73	74	75	75
40	62	70	67	84	85	75	80	73	73	78	69	80	80	81	80
50	62	67	67	84	81	74	76	73	71	73	67	82	81	81	81
63	64	76	73	84	84	76	80	73	71	73	67	77	77	79	80
80	61	70	70	82	86	78	83	74	69	72	71	79	78	79	78
100	62	72	70	88	94	92	87	78	73	70	75	83	81	82	82
125	68	68	68	84	88	84	77	75	74	69	74	84	86	85	83
160	60	71	72	90	89	78	78	73	72	68	70	87	88	88	86
200	67	72	73	91	87	79	80	78	73	74	71	87	87	87	89
250	63	73	72	83	83	76	79	71	68	65	69	88	88	88	88
315	56	72	70	81	81	73	78	69	67	65	67	89	88	87	87
400	66	73	73	79	79	74	79	72	73	71	73	88	87	86	86
500	58	70	70	75	76	77	78	71	72	70	73	84	84	82	82
630	62	60	67	74	76	77	78	71	72	71	73	92	82	80	81
800	56	65	64	72	72	75	79	70	72	70	72	8.	80	78	78
1000	56	64	63	67	69	75	75	71	71	71	72	78	77	77	75
1250	58	62	61	66	74	79	75	72	71	71	72	77	76	76	75
1600	55	63	62	68	82	84	74	72	72	72	73	76	76	75	74
2000	54	62	62	65	75	77	74	70	72	72	73	77	77	75	75
2500	64	69	60	74	79	82	82	78	79	79	82	89	88	86	86
3150	50	58	57	69	71	69	76	66	67	65	69	81	80	78	78
4000	49	56	53	62	71	66	72	64	65	61	65	83	82	80	80
5000	45	49	48	56	67	58	69	58	59	55	57	82	81	79	79
6300	41	46	45	54	63	53	65	54	55	52	53	81	80	78	79
8000	35	45	42	51	60	51	60	51	52	48	50	79	77	76	76
10000	35	45	41	46	60	50	56	47	48	45	45	73	71	69	70
12500	35	45	40	45	60	50	51	45	45	45	45	66	65	63	63
OVERALL	77	84	83	97	98	95	93	87	86	86	87	99	97	97	97

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: 2 MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT:
C-141A AIRCRAFT
IN-FLIGHT NOISE LEVELS

OPERATION:

IDENTIFICATION:
OMEGA 3.2
TEST AF-079-881
RUN 02

30 JUN 80

FREQ (HZ)	LOCATION/CONDITION 9/H	10/H	11/H	12/H	1/I	1/J	1/K	1/L	1/M	1/N
25	80	81	77	77	76	74	84	83	83	92
31.5	82	79	74	78	74	77	82	79	81	91
40	85	82	78	80	72	79	81	78	81	91
50	83	80	76	78	73	71	86	86	84	94
63	80	79	71	74	71	76	94	94	89	98
80	80	80	73	75	76	87	92	90	86	94
100	83	84	73	74	81	80	89	87	81	90
125	86	81	73	74	72	74	94	90	81	82
160	87	85	77	76	74	78	92	89	82	87
200	86	88	76	76	79	74	94	90	83	84
250	87	86	75	75	72	73	90	88	78	81
315	88	85	77	75	72	71	84	83	75	79
400	85	83	79	80	74	75	84	83	77	77
500	82	80	76	78	76	75	79	79	73	75
630	81	84	77	79	78	75	79	77	71	75
800	79	79	76	78	75	73	74	73	69	71
1000	77	77	75	76	75	73	73	73	74	72
1250	75	76	75	76	75	74	72	72	75	71
1600	74	75	75	76	76	74	70	71	70	68
2000	73	74	73	75	75	72	71	72	70	67
2500	84	84	83	85	84	80	86	84	87	79
3150	76	77	74	74	72	63	69	68	68	61
4000	77	76	73	73	68	60	68	69	66	61
5000	75	74	70	69	60	55	67	67	67	55
6300	75	72	68	67	55	52	61	60	62	55
8000	72	69	64	63	50	49	57	55	60	55
10000	66	64	60	59	46	46	55	55	55	55
12500	60	59	56	54	43	45	55	55	55	55
OVERALL	97	96	90	91	90	91	101	99	95	102

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: 2 MEASURED SOUND PRESSURE LEVEL (DB) OCTAVE BAND

IDENTIFICATION:
OMEGA 3.2
TEST AF-079-001
RUN 01

30 JUN 80

NOISE SOURCE/SUBJECT:
C-141A AIRCRAFT
IN-FLIGHT NOISE LEVELS

OPERATION:

FREQ (HZ)	LOCATION/CONDITION 1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	2/H	3/H	4/H	5/H	6/H	7/H	8/H
31.5	73	76	75	99	98	78	84	80	79	82	75	81	81	82	82
63	67	77	75	88	89	81	85	78	75	77	73	84	83	84	85
125	65	75	75	93	96	93	88	81	78	74	78	90	91	90	89
250	69	77	77	92	89	81	84	79	75	75	74	93	92	92	92
500	65	75	75	81	82	81	83	76	77	75	78	94	90	88	88
1000	61	69	68	74	77	81	81	76	76	75	77	83	82	82	81
2000	64	70	70	75	84	87	83	80	81	80	83	89	88	87	87
4000	53	60	59	78	75	71	78	68	69	67	71	87	86	83	84
8000	42	50	47	56	66	56	67	56	57	54	55	83	82	80	81
OVERALL	77	84	83	97	98	95	93	87	86	86	87	99	97	97	97

TABLE: 2 MEASURED SOUND PRESSURE LEVEL (DB) OCTAVE BAND

IDENTIFICATION:
OMEGA 3.2
TEST AF-879-881
RUN 02
30 JUN 88
PAGE J2

NOISE SOURCE/SUBJECT:
C-141A AIRCRAFT
IN-FLIGHT NOISE LEVELS

OPERATION:

FREQ (HZ)	LOCATION/CONDITION 9/H	10/H	11/H	12/H	1/I	1/J	1/K	1/L	1/M	1/N
31.5	87	86	81	83	79	82	87	85	86	96
63	86	84	79	81	78	87	96	96	91	100
125	90	88	79	79	82	83	97	93	86	92
250	92	91	81	80	80	77	95	92	84	86
500	88	87	82	83	81	80	86	85	79	80
1000	82	82	80	81	80	78	78	77	78	76
2000	85	85	84	86	85	81	86	85	87	79
4000	81	80	77	77	73	65	73	73	72	64
8000	77	74	70	69	56	54	63	62	65	60
OVERALL	97	96	90	91	90	91	101	99	95	102

TABLE: 3 MEASURES OF HUMAN NOISE EXPOSURE

IDENTIFICATION:
OMEGA 3.2
TEST AF-879-001
RUN 81
30 JUN 80
PAGE H1

NOISE SOURCE/SUBJECT:
C-141A AIRCRAFT
IN-FLIGHT NOISE LEVELS

OPERATION:

	LOCATION/CONDITION														
	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	2/H	3/H	4/H	5/H	6/H	7/H	8/H
HAZARD/PROTECTION															
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR															
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR															
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)															
NO PROTECTION															
OASLC	75	83	82	96	98	94	92	87	86	85	86	99	97	96	96
OASLA	69	77	76	85	88	89	88	83	84	83	85	96	94	92	92
T	960	960	960	484	240	202	240	571	480	571	484	60	85	120	120
MINIMUM GPL EAR MUFFS															
OASLA*	58	59	59	74	75	72	69	63	61	59	61	75	74	73	73
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS															
OASLA*	44	53	53	64	64	62	62	56	56	55	57	71	68	67	67
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
FLENTS EAR PLUGS															
OASLA*	45	54	53	65	65	63	62	57	56	55	57	71	69	68	68
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
H-157 IN-FLIGHT COMMUNICATION UNIT															
OASLA*	52	61	61	76	76	72	70	64	62	61	63	77	76	75	75
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
PSIL	64	71	71	77	81	83	82	77	78	77	79	89	87	86	85
ANNOYANCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)															
TONE CORRECTION (C IN DB)															
PNLT	87	94	93	103	106	106	106	101	101	100	103	114	112	111	111
C	4	3	3	2	2	3	2	3	3	3	4	3	3	3	3

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE

3

IDENTIFICATION: OMEGA 3.2, TEST AF-879-801, RUN 82, 30 JUN 80, PAGE H2

NOISE SOURCE/SUBJECT: C-141A AIRCRAFT IN-FLIGHT NOISE LEVELS

OPERATION:

	LOCATION/CONDITION									
	9/H	10/H	11/H	12/H	1/I	1/J	1/K	1/L	1/M	1/N
HAZARD/PROTECTION										
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR										
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR										
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)										
NO PROTECTION										
OASLC	96	95	89	91	89	90	101	99	94	101
OASLA	91	91	88	89	88	85	91	89	89	85
T	143	143	241	202	240	404	143	202	202	404
MINIMUM SPL EAR MUFFS										
OASLA*	73	72	64	65	65	67	70	76	70	77
T	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS										
OASLA*	67	66	61	62	60	59	68	66	61	64
T	960	960	960	960	960	960	960	960	960	960
FLENTS EAR PLUGS										
OASLA*	68	67	61	62	60	59	69	67	61	66
T	960	960	960	960	960	960	960	960	960	960
H-157 IN-FLIGHT COMMUNICATION UNIT										
OASLA*	75	74	67	67	67	68	80	77	71	77
T	960	960	960	960	960	960	960	960	960	960
COMMUNICATION										
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)										
PSIL	85	85	82	84	82	80	83	82	81	78
ANNOYANCE										
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)										
TONE CORRECTION (C IN DB)										
PNLT	110	109	106	108	106	103	112	110	111	106
C	3	3	3	4	4	4	5	5	6	5

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

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